

Honeywell Bull

TIME-SHARING
APPLICATIONS LIBRARY
GUIDE
VOLUME II - STATISTICS
ADDENDUM A

SERIES 600/6000

APPLICATIONS

SUBJECT:

Additions to the Statistical Time-Sharing Programs.

SPECIAL INSTRUCTIONS:

This update, Order Number DA44A, is the first addendum to DA44, Revision 0, dated June 1971. The attached pages are to be inserted into the manual as indicated in the collating instructions on the back of this cover.

Three additional programs are being added with this addendum; these programs are listed in the Preface.

NOTE: This cover should be inserted following the manual cover to indicate the updating of the document with Addendum A.

DATE:

December 1972

ORDER NUMBER:

DA44A, Rev. 0

6359

1.3173

Printed in France

Ref.: 19.53.107 A1

COLLATING INSTRUCTIONS

To update this manual, remove old pages and insert new pages as follows:

<u>Remove</u>	<u>Insert</u>
iii, iv	iii, Blank
ix through xiii	ix through xiv
FOURIER	FOURIER
	STAT17 after STAT16
	STAT20 after STAT18
	STAT21 after STAT20

PREFACE

This manual describes and discusses the usage of the statistical time-sharing programs available with Series 600 and 6000 information processing systems. The programs are listed alphabetically in the table of Contents.

Each program description includes the purpose of the program; language in which it is written; method of approach, if applicable; instructions for use; restrictions if any; and sample problems and solutions. In the sample solutions, all information typed by the user is underlined.

The instructions provided assume that the programs are available in the user master catalog LIBRARY and accessible with READ or EXECUTE permission. In the sample solution printouts, the programs had already been accessed using the GET command, and/or copied onto the current file using the OLD or LIB command.

Time-sharing programs for other classifications are also available from Honeywell under the following titles:

Series 600/6000 Time-Sharing Applications Library Guide, Volume I - Mathematics,
Order No. DA43

Series 600/6000 Time-Sharing Applications Library Guide, Volume III - Industry,
Order No. DA45

Series 600/6000 Time-Sharing Applications Library Guide, Volume IV - Business
and Finance, Order No. DA46

A complete listing of the programs in the library is available by listing the library program, CATALOG. A copy of this listing follows the Contents. Additional programs incorporated in the December 1972 Addendum.

STAT17
STAT20
STAT21

Series 600/6000 Time Sharing Applications Library programs are available to users of the DATANETWORK service. Please contact your local Honeywell representative for further details.

This document describes programs that originated from a variety of sources, such as users and the Honeywell field organization. The programs and documentation are made available in the general form and degree of completeness in which they were received. Honeywell Information Systems Inc., therefore, neither guarantees the accuracy of the programs nor assumes support responsibility.

CATALOG OF SERIES 600 / 6000 T-S LIBRARY PROGRAMS

FILE TYPE INDICATOR:

LANGUAGE (FIRST LETTER)	MODE (FOLLOWING LETTERS)
A ALGOL	P (OR BLANK) PROGRAM
B BASIC	S SUBROUTINE(S)
C CARDIN	F FUNCTION(S)
D DATABASIC	P-S PROGRAM WITH EXTRACTABLE SUBROUTINE(S)
E TEXT EDITOR	R RELOCATABLE OBJECT (C*)
F FORTRAN	H SYSTEM LOADABLE OBJECT (H*)

ALL FILES ARE SOURCE MODE UNLESS OTHERWISE INDICATED.

SUBJECTS

DOCUMENTATION MANUAL

MATHEMATICS (MA)ORDER # DA43

- INTEGRATION
- DIFFERENTIATION, DIFFERENTIAL EQ.
- INTERPOLATION
- POLYNOMIALS
- LINEAR EQUATIONS
- MATRICES
- NON-LINEAR EQUATIONS
- SPECIAL FUNCTION EVALUATION
- LOGIC AND NUMBER THEORY

STATISTICS (ST)ORDER # DA44

- CURVE FITTING AND REGRESSION
- ANALYSIS OF VARIANCE
- PROBABILITY DISTRIBUTIONS
- CONFIDENCE LIMITS
- HYPOTHESIS TESTING
- DESCRIPTIVE STATISTICS
- RANDOM NUMBER GENERATION
- MISCELLANEOUS STATISTICS

BUSINESS AND FINANCE (BF)ORDER # DA46

MANAGEMENT SCIENCE AND OPTIMIZATION (MS)ORDER # DA45

- LINEAR PROGRAMMING
- INTEGER PROGRAMING
- NON-LINEAR OPTIMIZATION
- NETWORK ANALYSIS
- FORECASTING
- SIMULATION

ENGINEERING (EN)

GEOMETRIC AND PLOTTING (GP)

EDUCATION AND TUTORIAL (ED)

DEMONSTRATION (DE)

UTILITY AND MISCELLANEOUS (UM)

THE DOCUMENTATION FOR THESE PROGRAMS IS AVAILABLE IN FOUR MANUALS:
 SEE ORDER # DA43 FOR PROGRAMS IN MATHEMATICS
 ORDER # DA44 FOR PROGRAMS IN STATISTICS
 ORDER # DA46 FOR PROGRAMS IN BUSINESS AND FINANCE
 ORDER # DA45 FOR PROGRAMS IN ALL OTHER CATEGORIES.

SUBROUTINES THAT ARE CALLED BY A PROGRAM AND MUST BE EXECUTED WITH IT
 ARE LISTED IN BRACKETS AT THE END OF THE DESCRIPTION.

THESE PROGRAMS HAVE ALL BEEN REVIEWED AND TESTED BUT NO RESPONSIBILITY
 CAN BE ASSUMED.

*****MA--MATHEMATICS*****

INTEGRATION

CLCINT	FF	INTEGRATION BY SIMPSON'S RULE
FINT	FF	EVALUATE FOURIER INTEGRALS BY FILON'S FORMULA
GAHER	FF	GAUSS-HERMITE QUADRATURE
GALA	FF	GAUSS-LAGUERRE QUADRATURE
GAUSSN	FF	EVALUATE DEFINITE DOUBLE OR TRIPLE INTEGRALS
GAUSSQ	FF	GAUSSIAN QUADRATURE
NC0ATES	FP-S	NEWTON-C0ATES QUADRATURE
NUMINT	B	GAUSSIAN QUADRATURE
R0MBINT	FP-S	R0MBERG INTEGRATION
SPLINE	B	INTEGRATE TABULATED FUNCTION BY SPLINE FITS

DIFFERENTIATION, DIFFERENTIAL EQ.

AMPBX	FS	ADAMS-M0ULTON FOR 1ST-0RDER DIFF. EQNS [RKPBX]
FDRVUL	FF	DIFFERENTIATE TABULATED FUNCTION, UNEQUAL SPACING
HDRVEB	FF	DIFFERENTIATE TABULATED FUNCTION, EQUAL SPACING
RKPBX	FS	RUNGE-KUTTA FOR 1ST-0RDER DIFF. EQNS

INTERPOLATION

SPLINT	B	SPLINE INTERPOLATION
TNT1	FF	SINGLE LAGRANGIAN INTERPOLATION [TLU1]
TNT2	FF	DOUBLE LAGRANGIAN INTERPOLATION [TLU1]
TNT2A	FF	VARIABLE DOUBLE LINEAR INTERPOLATION [TLU1]

POLYNOMIALS

BIC0F	FS	CALCULATE BINOMIAL COEFFICIENTS
CLPLY	FF	EVALUATE REAL POLY AT REAL ARGUMENT
CP0LY	FS	FINDS ZEROES OF A COMPLEX POLYNOMIAL
CP0LY-DR	FP	FINDS ZEROES OF A COMPLEX POLYNOMIAL [CP0LY]
DVALG	FS	POLYNOMIAL DIVISION
EUALG	FS	G.C.D. OF TWO POLYNOMIALS [DVALG]
MTALG	FS	MULTIPLY POLYNOMIALS
PLMLT	FS	REAL POLY COEFFICIENTS RECONSTRUCTED FROM REAL ROOTS
P0LRTS	FP	SOLUTION OF POLY BY BAIRSTOWS METHOD
P0LYC	FS	REAL POLY COEFFICIENTS RECONSTRUCTED FROM COMPLEX ROOTS
P0LYV	FS	EVALUATE REAL POLY AT COMPLEX ARGUMENT
QUADEQ	B	SOLUTION TO QUADRATIC EQUATIONS
R00TER	B	SOLUTION OF POLY BY BAIRSTOWS METHOD
ZC0P	FP	ROOTS OF POLYNOMIAL WITH COMPLEX COEFF.
ZC0P2	FS	ROOTS OF POLYNOMIAL WITH COMPLEX COEF. [ZC0P2]
Z0RP	FP	ROOTS OF REAL POLY
Z0RP2	FS	ROOTS OF REAL POLY

LINEAR EQUATIONS

GJSIMEQ	FS	SOLVE LINEAR SYSTEMS BY GAUSS-JORDAN
GSEIDEL	FP-S	SOLVE LINEAR SYSTEMS BY GAUSS-SEIDEL
LINEQ	FS	SOLVE LINEAR SYSTEMS BY GAUSSIAN ELIMINATION
LINSR	FP	SOLVE LINEAR SYSTEMS BY GAUSSIAN ELIMINATION [LINEQ]
SIMEQN	B	SOLVE LINEAR SYSTEMS BY MATRIX INVERSION

MATRICES

DETE	FF	EVALUATE DETERMINANT OF REAL MATRIX
D0MEIG	FP-S	DOMINANT EIGENVALUES OF REAL MATRIX
EIG1	FS	EIGENVALUES OF SYM MATRIX BY JAC0BI METHOD
EIGNHC	FS	EIGENVALUES & VECTORS OF COMPLEX NON-HERMITIAN MATRICES
EIGNSR	FS	EIGENVALUES & VECTORS OF REAL NON-SYMMETRIC MATRICES
EIGSR	FP	EIGENVALUES AND VECTORS OF REAL SYM. MATRIX [EIG1]
LINSO	FS	SOLVE LIN. SYS. W/ SYMMETRIC DOUBLE PREC. COEF. MATRIX
LINSS	FS	SOLVE LIN. SYS. W/ SYMMETRIC SINGLE PREC. COEF. MATRIX
MTINV	FS	MATRIX INVERSION BY PIVOTS
MTMPY	FS	MATRIX MULTIPLICATION
MTRAN	FS	TRANSPOSE A MATRIX
SPEIG1	FS	SPECIAL EIGEN PROBLEMS [EIG1]
SYMEIG	FP	EIGENVALUES OF SYM MATRIX BY JAC0BI METHOD

NON-LINEAR EQUATIONS

BROWN	FS	SOLN OF SIMULTANEOUS SYSTEMS BY BROWN METHOD
SECANT	FS	SOLN OF SIMULTANEOUS SYSTEMS BY SECANT METHOD [MTINV]
SOLN	FF	ZERO OF AN ARBITRARY FUNCTION
ZEROES	B	ZERO, MAX, MIN OF FUNCTION

SPECIAL FUNCTION EVALUATION

ARCTAN	FF	ARCTANGENT IN RADIANS OF Y/X
BESL	FS	BESSEL FUNCTION [GAMF]
COMP1	FF	EVALUATES REAL HYPERBOLIC TRIG FUNCTIONS
COMP2	FS	COMPLEX MULT. AND DIVISION
COMP3	FS	EVALUATES VARIOUS FUNCTIONS FOR COMPLEX ARGUMENT [COMP2]
ERRF	FF	ERROR FUNCTION
ERRINV	FF	INVERSE ERROR FUNCTION
FRESNL	FS	EVALUATES FRESNAL INTEGRALS
GAMF	FF	GAMMA FUNCTION
JACELF	FS	EVALUATES JACOBIAN ELLIPTIC FUNCTIONS SN, CN, DN
ORTHF	FF	EVALUATE ORTHOGONAL POLYNOMIALS
STIRLING	FP-S	N FACTORIAL BY STIRLINGS APPROXIMATION
TMFCEV	B	EVALUATE DAMPED OR UNDAMPED FOURIER SERIES

LOGIC AND NUMBER THEORY

4SQRS	B	WRITES INTEGERS AS SUM OF SQUARES OF FOUR INTEGERS
BASE	FP	CONVERTS NUMBERS FROM ONE BASE TO ANOTHER
CONCLUDE	B	DETERMINES LOGICAL CONCLUSIONS FROM PROPOSITIONAL LOGIC
GCDN	FS	G.C.D. OF N INTEGERS

*****ST--STATISTICS*****

CURVE FITTING AND REGRESSION

CFIT	FP	LEAST SQRS. POLY. WITH RESTRAINTS
CURFIT	B	FITS SIX DIFFERENT CURVES BY LEAST SQRS
F0RIR	FP	LEAST SQUARES ESTIMATE OF FINITE FOURIER SERIES MODEL
FOURIER	B	COEFF OF FOURIER SERIES TO APPROX A FUNCTION
LINEFIT	FS	LEAST SQRS LINE
LINREG	B	LST. SQRS. BY LINEAR, EXPONENTIAL, OR POWER FUNCTION
LSPCFP	FP	LEAST SQRS POLYNOMIAL FIT
LSQMM	FS	GENERALIZED POLY FIT BY LEAST SQRS OR MIN-MAX
MREG1	FP	MULTIPLE LINEAR REGRESSION
MULFIT	B	MULTIPLE LINEAR FIT WITH TRANSFORMATIONS
ORPOL	FP	LEAST SQRS FIT WITH ORTHOGONAL POLYS
POLFIT	B	LEAST SQRS POLYNOMIAL FIT
POLFT	FP	LEAST SQRS POLYNOMIAL FIT
SMLRP	FP	MULTIPLE LINEAR REGRESSION
SMLRP0BJ	FHP	SYSTEM LOADABLE FILE FOR SMLRP
STAT20	B	EFFROYMSON'S MULTIPLE LINEAR REGRESSION ALGORITHM
STAT21	B	COMPUTES MULTIPLE LINEAR REGRESSIONS

ANALYSIS OF VARIANCE

ANOVA	FP	ONE OR TWO WAY ANALYSIS OF VARIANCE
ANVA1	FP	ONEWAY ANALYSIS OF VARIANCE
ANVA3	FP	THREE WAY ANALYSIS OF VARIANCE
ANVA5	FP	MULTIPLE VARIANCE ANALYSIS
KRUWAL	FP	KRUSKAL-WALLIS 2-WAY VARIANCE [XINGAM]
ONEWAY	B	ONEWAY ANALYSIS OF VARIANCE
STAT13	B	ANALYSIS OF VARIANCE TABLE, 1-WAY RANDOM DESIGN
STAT14	B	ANALYSIS OF VARIANCE TABLE FOR RANDOMIZED BLOCK DESIGN
STAT15	B	ANALYSIS OF VARIANCE TABLE FOR SIMPLE LATIN-SQ DESIGN
STAT16	B	ANALYSIS OF VARIANCE TABLE, GRAECO-LATIN SQUARE DESIGN
STAT17	B	ANOVA TABLE OF BALANCED INCOMPLETE BLOCK DESIGN
STAT18	B	ANALYSIS OF VARIANCE TABLE, YOUNDEN SQUARE DESIGN
STAT33	B	ANALYSIS OF VARIANCE TABLE, 1-WAY RANDOM DESIGN

PROBABILITY DISTRIBUTIONS

ANPF	FF	NORMAL PROBABILITY FUNCTION [ERRF]
BETA	FF	BETA DISTRIBUTION
BINDIS	B	BINOMIAL PROBABILITIES
EXPLIM	B	EXPONENTIAL DISTRIBUTIONS
POISSON	FF	POISSON DISTRIBUTION FUNCTION
PROBC	FP	PROBABILITIES OF COMBINATIONS OF RANDOM VARIABLES
PROVAR	B	NORMAL AND T-DISTRIBUTION
TDIST	FF	T-DISTRIBUTION [BETA]
XINGAM	FF	INCOMPLETE GAMA FUNCTION

CONFIDENCE LIMITS

BAYES	B	DIFFERENCE OF MEANS IN NON-EQUAL VARIANCE
BICONF	B	CONF. LIMITS FOR POPULATION PROPORTION (BINOMIAL)
BINOM	FP	BINOMIAL PROBABILITIES AND CONFIDENCE BANDS
COLINR	B	CONFIDENCE LIMITS ON LINEAR REGRESSIONS
CONBIN	B	CONF. LIMITS FOR POPULATION PROPORTION (NORMAL)
CONDIF	B	DIFFERENCE OF MEANS IN EQUAL VARIANCE
CONLIM	B	CONF. LIMITS FOR A SAMPLE MEAN
STAT05	B	CONFIDENCE INTERVAL FOR MEAN BY SIGN TEST
STAT06	B	CONFIDENCE LIMITS, WILCOXON SIGNED RANK SUM TEST

HYPOTHESIS TESTING

BITEST	B	TEST OF BINOMIAL PROPORTIONS
CHISQR	FS	CHI-SQUARE CALCULATIONS
CORREL	FP	CONTINGENCY COEFFICIENT [XINGAM]
CORRL2	FP	CORRELATION COEFFICIENT [TDIST;BETA]
KOKO	FP	KOLMOGOROV-SMIRNOV TWO SAMPLE TEST [XINGAM]
SEVPRO	B	CHI-SQUARE
STAT01	B	MEAN, STD OF MEAN, ... , T-RATIO, 2 GROUPS, PAIRED
STAT02	B	MEANS, VARIANCES, AND T-RATIO 2 GROUPS, UNPAIRED DATA
STAT04	B	CHI-SQUARE AND PROBABILITIES, 2X2 TABLES
STAT08	B	COMPARES TWO GROUPS OF DATA USING THE MEDIAN TEST
STAT09	B	COMPARE 2 DATA GROUPS, MANN-WHITNEY 2-SAMPLE RANK TEST
STAT11	B	SPEARMAN RANK CORRELATION COEF. FOR 2 SERIES OF DATA
STAT12	B	COMPUTES CORRELATION MATRIX FOR N SERIES OF DATA
TAU	FP	KENDALL-RANK CORRELATION

DESCRIPTIVE STATISTICS

MANDSD	B	FIND MEAN, VARIANCE, STD
STAT	FP	FIND SEVERAL STATISTICS FOR SAMPLE DATA [ANPF;ERRF]
STATAN	B	FIND VARIOUS STATISTICAL MEASURES
TESTUD	B	SAMPLE STATISTICS
UNISTA	B	DESCRIPTION OF UNI-VARIANT DATA

RANDOM NUMBER GENERATION

FLATSORC	C	CARDIN SOURCE FILE FOR FLAT
FLAT	FRF	UNIFORM RANDOM NUMBER GENERATOR
RANDX	FF	RANDOM #'S, UNIFORM DIST. BETWEEN 0 AND 1
RNDNRM	FF	CALCULATES NORMAL RANDOM NUM. [FLAT]
UNIFM	FRF	UNIFORM RANDOM NUMBER GENERATOR
UNIFMSOR	C	CARDIN SOURCE FILE FOR UNIFM
URAN	FRF	UNIFORM RANDOM NUMBER GENERATOR
URANSORC	C	CARDIN SOURCE FILE FOR URAN
XNORI	FF	NORMAL RANDOM NUMBERS, VARIABLE MEAN, STD [RANDX]
XNORM	FF	NORMAL RANDOM NUMBERS, MEAN 0, STD 1. [RANDX]

MISCELLANEOUS STATISTICS

FACTAN	FP	FACTOR ANALYSIS
STADES		EXPLANATION OF COLINR, CURFIT, MULFIT, UNISTA

*****BF--BUSINESS AND FINANCE*****

ANNUIT	B	ANNUITIES, LOANS, MORTGAGES
BLDG COST	B	ANALYZE BUILDING COSTS
BONDATA	B	ANALYSIS OF A BOND INVESTMENT PORTFOLIO
BONDPR	B	COMPUTES PRICE AND ACCRUED INTEREST OF A BOND
BONDSW	B	CALCULATES THE EFFECT OF A BOND SWITCH
BONDYD	B	COMPUTES BOND YIELDS
CASHFLOW	B	PREDICTS NEXT YEARS CASH FLOW
DEPREC	B	CALCULATES DEPRECIATION BY FOUR METHODS
INSTLO	B	CALCULATES MONTHLY PAYMENT SCHEDULE ON INSTALLMENT LOAN
INVANL	FP	RETURN ON INVESTMENT ANALYSIS
LESSEE	B	COMPARES A LEASE WITH PURCHASE OF EQUIPMENT
LESSIM	B	SIMULATES LESSOR'S CASH FLOW AND RATE OF RETURN
LESSOR	B	CALCULATES THE LESSOR'S CASH FLOW & RATE OF RETURN
MAKE-BUY	B	TO MAKE OR TO BUY DECISIONS
MGSIM	FHP	SIMULATES COMPETITIVE INTERACTION OF COMPANIES
MGSIM-CS	FRP	OBJECT DECKS FOR MGSIM
MGSIM-IN		ON LINE INSTRUCTIONS FOR MGSIM
MORTCST	B	MORTGAGE SCHEDULE FOR VARIOUS TERMS
MORTGAGE	FP	CALCULATES A MORTGAGE REPAYMENT SCHEDULE
RETURN	B	COMPUTES ANNUAL RETURNS FOR A SECURITY FROM ANNUAL DATA
SALDATA	B	COMPUTES PROFITABILITY OF DEPARTMENTS OF A FIRM
SAVING	B	SAVINGS PLAN CALCULATIONS
SMLBUS	B	PAYMENT SCHEDULES FOR A SMALL BUSINESS ADMST. LOAN
TRUINT	B	INTEREST RATE CALCULATIONS

*****MS--MANAGEMENT SCIENCE AND OPTIMIZATION*****

LINEAR PROGRAMMING

ASSIGNIT	B	THE ASSIGNMENT PROBLEM
LINPRO	B	LINEAR PROGRAMMING
LNPROG	FP	LINEAR PROGRAMMING
TRANSP0	B	THE TRANSPORTATION PROBLEM
UNDE0	FS	FINDS A SOLUTION FOR AN UNDERDETERMINED LINEAR SYSTEM

INTEGER PROGRAMMING

INT01	FP	ZIOMTS' MODIFICATION OF BALAS' ZERO-ONE ALGORITHM
INTLP	FP	GOMORY'S PURE AND MIXED INTEGER PROGRAMMING

NON-LINEAR OPTIMIZATION

CSM	FS	OPTIMIZE A LINEARLY CONSTRAINED CONVEX FUNCTION (UNDE0)
DAVIDON	B	DAVIDON'S UNCONSTRAINED OPTIMIZATION
GEOSIM	B	HEURISTIC SCHEDULING OF N JOBS IN A M MACHINE SHOP
GPROG	FHP	SOLVES GEOMETRIC PROGRAMMING PROBLEMS
GPROG-S0	C	CARDIN SOURCE FILE FOR GPROG (UNDE0;CSM)
JSSIM	B	SCHEDULES N JOBS IN A SHOP WITH M MACHINES
LOGIC3	FP	UNCONSTRAINED OPTIMIZATION
MAXOPT	FP	UNCONSTRAINED OPTIMIZATION

NETWORK ANALYSIS

CPM	FP	CRITICAL PATH METHOD
KILTER	FP	'OUT OF KILTER' ALGORITHM (MINIMUM COST CIRCULATION)
MAXFLOW	FP	MAXIMUM FLOW THRU NETWORK
PERT	B	SIMPLE ANALYSIS OF A PERT NETWORK
SHORTEST	FP	SHORTEST PATH - MIN SPANNING TREE

FORECASTING

COEFS	B	DETERMINE SEASONAL COEFFICIENTS ON TWO CYCLES
COMBI	B	DETERMINES ECONOMIC ORDER QUANTITY FOR INVENTORY ITEMS
OPTIM	F	OPTIMUM SERVICE LEVEL FOR ONE INVENTORY ITEM
TCAST	FP	TIME SERIES FORECASTING (TCAST1;TCAST2)
TCAST1	FH	OVERLAY MODULE OF TCAST
TCAST	FHP	TIME SERIES FORECASTING
TCAST2	FH	OVERLAY MODULE OF TCAST
TCAST1	FH	OVERLAY MODULE OF TCAST
SMOOTH	FS	TRIPLE SMOOTHING OF A TIME SERIES

SIMULATION

GASPDAT E DATA FILE FOR SAMPLE PROGRAM GASPSAMP
 GASPIIA FS 'GASP' SIMULATION SYSTEM
 GASPSAMP FP SAMPLE PROGRAM FOR GASPIIA (GASPIIA; GASPDAT)

*****EN--ENGINEERING*****

ACNET FP FREQUENCY RESPONSE OF A LINEAR CIRCUIT
 BEMDES B STEEL BEAM SELECTION
 GCVSIZ B GAS CONTROL VALVE COEFF.
 LCVSIC B LIQUID CONTROL VALVE COEFF.
 LFLTR B SYNTHESIZES ACTIVE LOW-PASS FILTERS (LFLDAT)
 LFLDAT DATA FOR LFLTR
 LFLTR INSTRUCTIONS FOR LFLTR
 LPFLT B DESIGN LOW PASS FILTERS
 NLNET FP GENERAL STEADY-STATE CIRCUIT ANALYSIS
 OTTO B OTTO CYCLE OF ENGINE
 PAVEIT B CALCULATES \$ COST AND TONS OF MATERIAL TO PAVE A ROAD
 PVT FP FINDS MOLAR VOLUME OF A GAS GIVEN TEMPERATURE AND PRES.
 SCVSIZ B STEAM CONTROL VALVE COEFF.
 SECAP B STEEL SECTION CAPACITIES

*****GP-GEOMETRIC AND PLOTTING*****

CIRCLE B DIVIDES A CIRCLE INTO N EQUAL PARTS
 PLOT FS PLOTS UP TO 9 CURVES SIMULTANEOUSLY
 PLOTTO B SIMULTANEOUSLY PLOTS 1 TO 6 FUNCTIONS
 POLPLO FP PLOTS EQNS IN POLAR COORDINATES
 SPHERE B SOLVES ANY SPHERICAL TRIANGLE
 TRIANG B SOLVES FOR ALL PARTS OF ANY TRIANGLE
 TWOPLO B SIMULTANEOUSLY PLOTS 2 FUNCTIONS
 XYPLO B PLOTS SINGLE-VALUED FUNCTIONS

*****ED--EDUCATION AND TUTORIAL*****

DRIVES FHP DRIVER FOR EXPR, A COMPUTER ASSISTED INST. LANG.
 EXPERN E EXPR TUTORIALS IN EXPR (N=1 TO 5) (PREPRS; DRIVES)
 PREPRS FHP PREPROCESSOR FOR EXPR, A COMPUTER ASSISTED INST. LANG.

*****DE--DEMONSTRATION*****

AMAZE B CONSTRUCTS MAZES - EACH UNIQUE
 BLKJAK B THE COMPUTER DEALS BLACKJACK
 POPING B POPULATION PROJECTIONS FOR AN AREA
 PRIME B PRIME FACTORIZATION OF A NUMBER
 XMAS B A HOLIDAY SING-ALONG, CHRISTMAS CARD AND GREETINGS

*****UM--UTILITY AND MISCELLANEOUS*****

ADATER FP-S A CALENDER DATING ROUTINE
 CATALOG E CATALOG OF SERIES 6000/600 T/S LIBRARY (THIS FILE)
 CONVRT B CONVERTS MEASUREMENTS FROM ONE SCALE TO ANOTHER
 DLSORT FS SORT TWO ARRAYS
 DESEQ FP STRIPS LINE SEQUENCE NUMBERS FROM A FILE
 REFORM FP REFORMATS A 'NFORM' FORTRAN SOURCE FILE TO 'FORM'
 RLINE FS READS LINE, OPTIONALLY STRIPS LINE # & COUNTS ENTRIES
 SLSORT FS SORT AN ARRAY
 TLUI FS TABLE SEARCH
 TPLSORT FS SORT THREE ARRAYS

END OF CATALOG

FOURIER

This BASIC program produces the fourier coefficients for a given periodic function of the form:

$$F(X) = A(0)/2 + \sum_{N=1}^M (A(N) * \cos(N*X) + B(N) * \sin(N*X))$$

which approximates a set of data points. The data points can be supplied either as discrete points equally spaced from 0 to 2π or as a set of defining functions.

INSTRUCTIONS

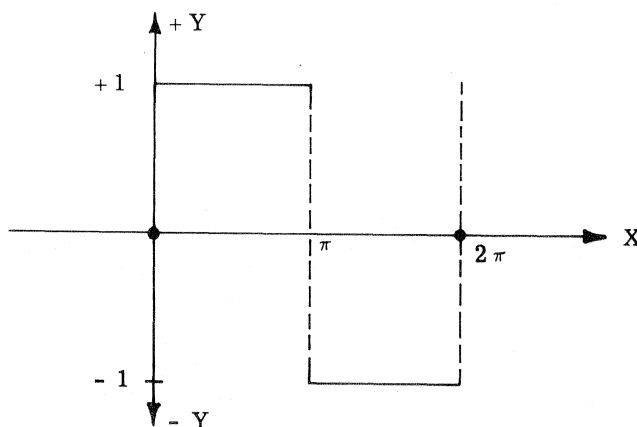
If the data to be approximated consists of discrete points, enter them in data statements at line number 6000 to 6998. If the data consists of defining functions, use lines 2000 to 4000 to define Y as a function of X, for example:

```
2000 IF X < 3.1416 THEN 2030
2010 LET Y = X13.1416
2020 GO TO 2040
2030 LET Y = X13.1416-1.0
```

Additional instructions can be found by running the program.

SAMPLE PROBLEM 1

Find the 9th order periodic function which best approximates the square wave:



by using 20 discrete points.

SAMPLE SOLUTION 1

```
*LIB FOURIER
READY
*RUN
```

-----FOURIER SERIES PROGRAM-----

DO YOU DESIRE INSTRUCTIONS---1=YES,0=NO ?1

INSTRUCTIONS:

THIS PROGRAM COMPUTES THE FOURIER COEFFICIENTS FOR A GIVEN PERIODIC FUNCTION OF THE FORM:

$$f(x) = \frac{A(0)}{2} + \sum_{N=1}^M [A(N) \cos(N \cdot x) + B(N) \sin(N \cdot x)]$$

GIVEN THE FOLLOWING DATA:

- 1A. A SUBROUTINE IN LINES 2000-4000 THAT DEFINES 'Y' AS A FUNCTION OF 'X' OVER THE INTERVAL $[0, 2\pi]$. 'PI' CONTAINS THE VALUE OF PI AND CAN BE USED IN THE SUBROUTINE. FOR EXAMPLE:

```
2000 IF X < PI THEN 2030
2010 LET Y=X/PI
2020 GO TO 2040
2030 LET Y=X/PI-1.0
2040 RETURN
```

OR

- 1B. DATA STATEMENTS IN LINES 6000-6998 CONTAINING THE TABULATED FUNCTION VALUES EQUALLY SPACED ON $[0, 2\pi]$ SO THAT THE FIRST POINT IS THE FUNCTION VALUE AT ZERO AND THE LAST POINT IS THE FUNCTION VALUE AT 2π .
2. THE NUMBER OF POINTS IF (1B) IS USED TO DEFINE THE FUNCTION. (REQUESTED DURING PROGRAM EXECUTION) IF (1A) IS USED, THE PROGRAM USES 201 POINTS.
3. THE DESIRED ORDER OF THE FOURIER COEFFICIENTS. (REQUESTED DURING PROGRAM EXECUTION)

NOTE: THE ORDER OF THE SERIES MUST BE $\geq$ ZERO.

THE # POINTS MUST BE $>$ TWICE THE ORDER OF THE SERIES.

B(0) IS ALWAYS ZERO.

READY

*6000 DATA 0,1,1,1,1,1,1,1,1,1,1

*6010 DATA -1,-1,-1,-1,-1,-1,-1,-1,-1,-1,0

*RUN

-----FOURIER SERIES PROGRAM-----

DO YOU DESIRE INSTRUCTIONS--1=YES,0=NO ?0

ARE YOU USING A FUNCTION TO SUPPLY DATA POINTS (TYPE '1') OR
A SET OF DATA POINTS (TYPE '2') ?2

HOW MANY DATA POINTS ?20

WHAT IS THE MAXIMUM ORDER OF THE HARMONICS TO BE FITTED ?9

FOURIER SERIES COEFFICIENTS:

A(I)	B(I)	I
8.66620E-07	0	0
-3.46504E-07	1.270337	1
1.98274E-08	-.0175653	2
-7.04884E-08	.4156748	3
1.80342E-09	-.0361369	4
4.62300E-08	.2399758	5
-2.66428E-08	-.0569656	6
1.37723E-07	.1611171	7
-1.31387E-07	-.0819297	8
5.56659E-07	.1143454	9

DO YOU WISH TO SEE A TABLE OF PREDICTED VS. ACTUAL VALUES
(1=YES,0=NO) ?1

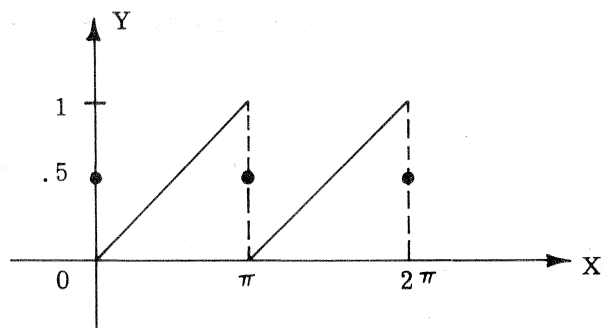
X	PRED-Y	ACTUAL-Y	ERROR
0	6.20530E-07	0	6.20530E-07
.330694	.9999991	1	8.94070E-07
.6613879	1.000001	1	9.38773E-07
.9920819	.9999991	1	8.79159E-07
1.322776	1.000001	1	1.05798E-06
1.65347	.9999991	1	8.79159E-07
1.984164	1.000001	1	1.20599E-06
2.314858	.9999992	1	7.89762E-07
2.645552	1.000002	1	1.62423E-06
2.976246	.9999999	1	8.94070E-08
3.30694	-.9999983	-1	1.65893E-06
3.637634	-.9999995	-1	4.76837E-07
3.968328	-.9999989	-1	1.07288E-06
4.299021	-.9999996	-1	3.79980E-07
4.629715	-.9999991	-1	8.71718E-07
4.960409	-.9999996	-1	3.72529E-07
5.291103	-.9999994	-1	5.33299E-07
5.621797	-.9999999	-1	1.34110E-07
5.952491	-1	-1	8.94070E-08
6.283185	2.56234E-07	0	2.56234E-07
TOTAL ERROR=	1.49360E-05		
MEAN ERROR=	7.46800E-07		

READY

*

SAMPLE PROBLEM 2

Find the 10th order periodic function which best approximates the saw tooth:



SAMPLE SOLUTION 2

```

*LIB FOURIER
READY
*2000 IF ABS(X) < 1E-4 THEN 2510
*2010 IF ABS(X-P1) < 1E-4 THEN 2510
*2020 IF ABS(X-2*P1) < 1E-4 THEN 2510
*2030 IF X > P1 THEN 2540
*2040 LET Y = X/P1
*2050 RETURN
*2510 LET Y = .5
*2520 RETURN
2540 LET Y = (X-P1)/P1
*2550 RETURN
*RUN

```

-----FOURIER SERIES PROGRAM-----

DO YOU DESIRE INSTRUCTIONS---1=YES,0=NO ?0
 ARE YOU USING A FUNCTION TO SUPPLY DATA POINTS (TYPE '1') OR
 A SET OF DATA POINTS (TYPE '2') ?1
 WHAT IS THE MAXIMUM ORDER OF THE HARMONICS TO BE FITTED ?10

FOURIER SERIES COEFFICIENTS:

A(I)	B(I)	I
.9998307	0	0
1.50909E-05	9.64904E-06	1
1.79135E-05	-.3181999	2
4.32217E-06	5.53251E-07	3
1.03547E-05	-.1589442	4
2.51442E-06	-6.33756E-08	5
5.79206E-06	-.1057887	6
1.66236E-06	-1.99909E-07	7
4.05776E-06	-.0791582	8
1.21063E-06	-2.49538E-07	9
3.18545E-06	-.0631376	10

DO YOU WISH TO SEE A TABLE OF PREDICTED VS. ACTUAL VALUES
(1=YES,0=NO) ? 1

X	PRED-Y	ACTUAL-Y	ERROR
0	.4999814	.5	1.85855E-05
.3141593	.0146056	.1	.0853944
.6283185	.2413414	.2	.0413414
.9424778	.2776137	.3	.0223853
1.256637	.4099661	.4	.0099551
1.570796	.4999118	.5	8.82000E-05
1.884956	.5898633	.6	.0101367
2.199115	.7222101	.7	.0222101
2.513274	.7584961	.8	.0415039
2.827433	.9852501	.9	.0852501
3.141593	.4999322	.5	6.77742E-05
3.455752	.0145697	.1	.0854303
3.769911	.2413107	.1999999	.0413107
4.08407	.2775868	.2999999	.0224132
4.398229	.4099427	.3999999	.0099428
4.712389	.4998936	.4999999	.0001053
5.026548	.5898507	.5999999	.0101492
5.340707	.7222056	.6999999	.0222057
5.654866	.7585007	.7999999	.0414992
5.969026	.9852731	.8999998	.0852733
6.283185	.4999831	.5	1.85855E-05
TOTAL ERROR=	.6367112		
MEAN ERROR=	.0303196		

READY

*

This BASIC program produces the ANOVA table of a balanced incomplete block design and F-ratio for treatments. The sum-of-squares is adjusted because of incompleteness.

INSTRUCTIONS

For instructions on data required and constraints of this program list the program by typing:

LIST 1-180

To see the format of data to be entered, type

LIST 900

Let run to end. The following is a sample of STAT17 output:

ANOVA TABLE:

ITEM	SS	DF	MS
GRAND TOTAL	3478	12	
GRAND MEAN	2133.333	1	
TREATMENTS	880.8333	3	293.6111
BLOCKS	100.6667	3	...BLOCK MS NOT ADJUSTED...
ERROR	363.1667	5	72.63333

F-RATIO = 4.042374 , 0N 3 AND 5 DEGREES OF FREEDOM.

READY

*

This BASIC program performs a multiple linear regression according to Effroymsen's algorithm.

INSTRUCTIONS

For instructions on data required and constraints of this program, list the program by typing

LIST 1-350

To see the format of the data to be entered, type

LIST 2000

Let run to end. The following is a sample of STAT20 output.

READY

*RUN

LIST THIS PROGRAM FOR INSTRUCTIONS.

EANS	22.86667	35.33333	46.13333	18
STANDARD DEVIATIONS	11.87354	7.217703	14.6671	4.035556
CORRELATION COEFFICIENTS	1	.5614845	.3023933	.5023637
	.5614845	1	.3267932	.2869154
	.3023933	.3267932	1	.7530242
	.5023637	.2869154	.7530242	1
DEPENDENT VARIABLE	1			
INDEX	8	STD.DEV.	T-RATIO	
0	18			
STANDARD ERROR OF Y		4.035556		
VARIABLE ENTERING	3			
F-LEVEL	17.02624			
INDEX	8	STD.DEV.	T-RATIO	
0	8.441651			
3	.2071897	.0502121	4.125287	
STANDARD ERROR OF Y		2.755605		
VARIABLE ENTERING	1			
F-LEVEL	2.847233			
INDEX	8	STD.DEV.	T-RATIO	
0	7.252562			
1	.1027441	.0608899	1.687375	
3	.1820381	.0492925	3.693015	
STANDARD ERROR OF Y		2.578492		

***** END OF PROBLEM *****

READY

*

This BASIC program computes one or more multiple linear regressions on a batch of data.

INSTRUCTIONS

For instructions on data required and constraints of this program, list the program by typing

LIST 1 - 510

To see the format of the data to be entered, type

LIST 2000

Let run to end. The following is a sample of STAT21 output:

**REGRESSION NUMBER 1 : DEPENDENT VARIABLE IS 4

INDEX	MEANS	STANDARD DEV.
3	46.13333	14.6671
4	18	4.035556

CORRELATION COEFFICIENTS

1	.7530242
---	----------

.7530242	1
----------	---

VARIANCE-COVARIANCE MATRIX

5.872178	-.116314
----------	----------

-.116314	.0025213
----------	----------

INDEX	B	STD. ERROR	T-RATIO
0	8.441652	2.423258	3.4835%
3	.2071896	.0502121	4.12528%

R-SQUARED= .5337411 R= .7305759

STAND. ERROR OF EST.= 2.755605 D.F.= 13

ACTUAL	PREDICTED	RESIDUAL
15	19.62989	-4.629892
16	12.37825	3.621745
14	14.65734	-.6573406
22	21.70179	.2982117
24	20.87303	3.12697
19	19.4227	-.4227022
13	14.45015	-1.450151
15	19.83708	-4.837082
23	21.28741	1.712591
12	15.27891	-3.27891
25	22.53055	2.469453
17	17.14362	-.1436162
18	17.76519	.2348149
19	16.52205	2.477953
18	16.52205	1.477953

DURBIN-WATSON STAT.= 2.373553

**REGRESSION NUMBER 2 : DEPENDENT VARIABLE IS 4

INDEX	MEANS	STANDARD DEV.
1	22.85667	11.87354
3	46.13333	14.6671
4	18	4.035556

CORRELATION COEFFICIENTS

1	.3023933	.5023637
.3023933	1	.7530242
.5023637	.7530242	1

VARIANCE-COVARIANCE MATRIX

5.638185	-.042909	-.0913387
-.042909	.0037076	-.0009076
-.0913387	-.0009076	.0024298

INDEX	B	STD. ERROR	T-RATIO
0	7.252562	2.374485	3.054371
1	.1027441	.0608899	1.687375
3	.1820381	.0492925	3.693015

R-SQUARED= .5917512 R= .7692536

STAND. ERROR OF EST.= 2.578492 D.F.= 12

DURBIN-WATSON STAT.= 1.683383

**REGRESSION NUMBER 3 : DEPENDENT VARIABLE IS 4

INDEX	MEANS	STANDARD DEVIATION
1	22.86667	11.87354
2	35.33333	7.217704
3	46.13333	14.5571
4	18	4.035556

CORRELATION COEFFICIENTS

1	.5614845	.3023933	.5023637
.5614845	.9999999	.3267932	.2869164
.3023933	.3267932	1	.7530242
.5023637	.2869164	.7530242	1

INDEX	B	STD. ERROR	T-RATIO
0	9.301253	3.802671	2.445979
1	.1288076	.0725231	1.775091
2	-.0841979	.1203255	-.699751
3	.1891981	.0514041	3.680504

R-SQUARED= .5736172 R= .7573752

STAND. ERROR OF EST.= 2.635137 D.F.= 11

ACTUAL	PREDICTED	RESIDUAL
15	19.59829	-4.598294
16	14.75456	1.24544
14	13.00608	.9939227
22	20.17709	1.822908
24	22.42748	1.572516
19	19.38901	-.3890102
13	13.69903	-.69903
15	19.50477	-4.50477
23	21.47822	1.521784
12	15.62455	-3.62455
25	24.08996	.9100376
17	16.0493	.9506997
18	16.53772	1.462282
19	18.0679	.932099
18	15.59503	2.403967

DURBIN-WATSON STAT.= 1.825883

**REGRESSION NUMBER 4 : DEPENDENT VARIABLE IS 3

INDEX	MEANS	STANDARD DEV.
4	18	4.035556
3	46.13333	14.6671

CORRELATION COEFFICIENTS

1	.7530242
.7530242	1

INDEX	B	STD. ERROR	T-RATIO
0	-3.129834	12.2157	-.2562141
4	2.736843	.66327	4.125288

R-SQUARED= .5337412 R= .7305759

STAND. ERROR OF EST.= 10.01516 D.F.= 13

DURBIN-WATSON STAT.= 2.13149

*****PROBLEM COMPLETED*****

READY

*

